## Supplementary

**Table S1** Summary of prenatal ultrasonographic features of persistent right venous valve

| Prenatal study | Maternal age (years) | Gestational weeks | Direct ultrasonic manifestation | Indirect ultrasonic manifestation | Prenatal diagnosis | Ultrasound findings after birth | Postnatal symptom | Surgery | outcome |
|---|---|---|---|---|---|---|---|---|---|
| Present case | 28 | 24, 29, 31 | At 31 w.g.: mobile echogenic membrane in the RA prolapsing into the TV orifice | At 29 w.g.: an abnormal TV and mildly hypoplastic RV<br>At 31 w.g.: moderately hypoplastic RV; normally inserted TV with a narrowed annulus, resulting in restricted forward blood flow; slightly narrowed pulmonary artery | Hypoplastic RV; prominent EV or CN | Mobile, echogenic membrane in the RA near the SVC prolapsing through the TV into the RV, resulting in a narrowed tricuspid inflow of 3 mm and a monophasic Doppler velocity of 1.4 m/s; tripartite, moderately hypoplastic RV; morphologically normal, hypoplastic TV; bidirectional flow at PFO and left-to-right shunt at PDA | Intermittent cyanosis on postnatal day 23 | A minimally invasive surgical correction was performed | $SaO_2$ improved to >90% immediately following surgery; at a 3-month follow-up. Echocardiography revealed normalized dimensions of the TV and RV with a left-to-right shunt across the PFO |
| Maroun, 2008, (4) | 29 | 12, 14 | At 14 w.g.: membrane in RA | At 12 w.g.: thickened NT (8 mm)<br>At 14 w.g.: VSD and widening of caval veins | – | – | – | – | Termination of the pregnancy; autopsy-CTD |
| Maroun, 2008, (4) | 27 | 12–14 | – | At 12 w.g.: thickened NT (11 mm)<br>At 14 w.g.: thickened NT (17 mm); and extreme hydrops | – | – | – | – | Termination of the pregnancy; autopsy-CTD |
| Bendadi, 2012, (5) | – | 19 | At 19 w.g.: multiple hyperechogenic structures originating from the IVC and the posterior wall of the RA and prolapsing into the TV | At 12 w.g.: thickened NT; hydrops; reversal flow in ductus venosus<br>At 20 w.g.: completely resolved hydrops; normalized nuchal fold and ductus venosus flow | CN | Multiple hyperechogenic structures prolapsing into TV without obstruction; smaller PA and PV | – | – | Further regression of the CN and normal development of the PV ring at the age of 6 months |
| Ghi, 2002, (6) | 35 | 22 | – | Disproportion in size of ventricles; smaller PA; thickened TV with restricted movements; mild pericardial effusion | TV dysplasia; functional PS | Thin-walled aneurysm-like structure in RA arising from the EV and prolapsing through the TV into the RV | Uneventful neonatal course | Discharged in good condition | Unchanged cardiac findings with a reverse (right-to-left) shunt across the PFO in 14 days after birth; a follow-up scan was arranged for 6 months later |
| Lasa, 2011, (7) | 35 | 22 | Membrane extending from the junction of the IVC and RA across the TV to the inferior limbus of the IAS prolapsing into the RV during diastole, interfering with tricuspid inflow | A small RV; reversal of flow in ductus venosus; hypoplastic TV and narrowed TV inflow; hypoplastic PV annulus; bidirectional flow in PDA | RV hypoplasia | – | – | – | Termination of the pregnancy; autopsy—RV hypoplasia; CTD |
| Arenas Ramírez, 2007, (8) | 36 | 19, 20 | NT (3 mm); large (3.6 mm × 1.7 mm), mobile, curvilinear and echogenic mass in RA prolapsing into RV through TV in diastole | Abnormal waveform with reversal flow during atrial contraction | EV; DD including pedunculated tumor | Postnatal echocardiography confirmed the prenatal findings | Asymptomatic and discharged on postnatal day 6 | – | Remained healthy at 7 months old with no changes in cardiac findings on follow-up echocardiography |
| Bhatia, 2021, (9) | 21 | 23 | Echogenic structure (3.4 mm × 4.6 mm) in the RA | – | Prominent CT; suspicion for right atrial tumors | Prominent CT | – | – | Regression during serial follow-up |
| Bhatia, 2021, (9) | 35 | 29 | Echogenic oscillating structure (4 mm × 6 mm) in the RA near the IVC prolapsing through the TV into the RV | – | A prominent CN; suspicion for RA tumors; VSD | CN; VSD | – | – | – |
| Fesslova, 2012, (10) | 31 | 22, 27, 37 | At 37 w.g.: fluctuating membrane in RA moving close to TV | At 22 w.g.: mildly hypoplastic RV and PS<br>At 27 w.g.: moderately hypoplastic RV with normal TV; slightly abnormal PV with mild PS<br>At 37 w.g.: hypoplastic RV; tiny flow across TV; mildly thickened PV with accelerated flow velocity | The EV or the CN | Moderately hypoplastic RV; smaller PV without a significant gradient; aneurysmatic membrane fluctuating in RA reaching the FO and passing through TV into RV, guiding flow to the FO and TV; bidirectional flow at PFO and PDA | Apgar 6/9 with $SPO_2$ of 90%; 75–78% at 2–3 days | The membrane was excised | Improved saturation and normalized dimensions of the RV at 9 months |
| Vigna, 2008, (11) | 31 | 22 | Membrane between the medial and lateral walls of RA | – | – | – | – | – | – |
| McLean, 2010, (12) | 25 | 35 | Horizontal echogenic membrane structure arising from the RA free wall and extending towards the margin of the FO | Laminar flow across the TV | CTD | Presence of the RA membrane when 10 months old | – | – | Not hemodynamically significant |

w.g., weeks of gestation; RA, right atrium; TV, tricuspid valve; RV, right ventricle; EV, Eustachian valve; CN, Chiari network; SVC, superior vena cava; PFO, patent foramen ovale; PDA, patent ductus arteriosus; $SaO_2$, oxygen saturation; NT, nuchal translucency; VSD, ventricular septal defect; CTD, cor triatriatum dexter; IVC, inferior vena cava; PV, pulmonary valve; PA, pulmonary atresia; PS, pulmonary stenosis; IAS, interatrial septum; DD, differential diagnosis; CT, crista terminalis; FO, foramen ovale.


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**Table S2** Summary of postnatal ultrasonographic features of persistent right venous valve

| Postnatal study | Age | Direct ultrasonic manifestation | Indirect ultrasonic manifestation | Final diagnosis | Symptom | Surgery | Outcome |
|---|---|---|---|---|---|---|---|
| Present case | 10 days, 23 days, 25 days | TTE: mobile, echogenic membrane in RA near SVC, prolapsing through TV into RV, causing limited RV inflow<br>TEE: fibrous, cord-like structure in RA, from SVC to TV, and restricting TV opening | Hypoplastic RA outlet; left-to-right shunting (10 days, 23 days) changing into right-to-left shunting (25 days) at PFO; left-to-right shunting at PDA | CN | At 10 days, difficulty feeding; at 23, 25 days, intermittent cyanosis ($SaO_2$ 70–84%); under conservative treatment, continuous cyanosis ($SaO_2$ with a nadir of approximately 40%) | Surgical resection after conservative followed-up | Normalization of oxygen saturations immediately after surgery; at a 3-month follow-up, normalized dimensions of the RA outlet on echocardiography |
| Bendadi, 2012, (5) | – | Thin membrane in RA prolapsing through TV | Membrane affecting normal outflow of the atrial blood through TV into RV causing right-to-left shunting through the PFO; reduced diameter of PV | CN | Cyanotic; decreased $SPO_2$ (82–90%) | Conservative followed-up | Within 4 months, regression of CN, the diameter of PV increased; ceased right-to-left shunting; normalization of $SpO_2$ |
| Sunthankar, 2021, (15) | 6 weeks | Hypermobile structure in RA occasionally overlaying TV and causing limited inflow | Mildly hypoplastic RV, PV and PA; right-to-left shunting through PFO | CTD | Oxygen saturations lower into 70s; at 5 weeks old, difficulty in feeding and episodes of oxygen saturations in the 50s | Surgical resection | Normalization of oxygen saturations; improvement in filling of RV |
| Sunthankar, 2021, (15) | 8 days | Membrane obstructing TV | Diverting IVC return across the PFO to LA; bidirectional atrial-level communication with elevated pulmonary pressure | CTD | Cyanotic with choking episodes and emesis; under conservative treatment, $SpO_2$ >75% | The family elected for surgical resection around 8 months of age | Oxygen saturations >97% with steady weight gain |
| Sunthankar, 2021, (15) | Within 1 day | CTD causing mildly increased TV mean inflow gradient as high as 7 mmHg | Directing IVC across the atrial septum | CTD | Increased work of breathing with hypoxia, with $SpO_2$ as low as 86% | Conservative followed-up | $SpO_2$ >93%; TV mean inflow gradients between 3 and 6 mmHg |
| Sunthankar, 2021, (15) | – | Membrane superior to the hypoplastic TV | Right-to-left shunting through atrial septum; PA with intact ventricular septum; PDA | CTD | – | Atrial septectomy, Glenn palliation, PA augmentation, ductal stent removal, and surgical resection at 5 months old; Fontan palliation later | Mildly hypoplastic TV |
| Galli, 2009, (16) | 2 days | Membrane adjacent to TV and coming through TV in diastole, prolapsing to trabecular portion of RV, obstructing inflow and filling of RV without reaching outflow portion | Diverting part of the blood from IVC to LA causing right-to-left shunting through atrial septum, resulting low pulmonary inflow; smaller RV; PDA with left-right shunt; pulmonary hypertension; ASD | CTD; ASD | Severe central cyanosis with $SpO_2$ 70%; a $PaO_2$ of 35 mmHg | Surgical resection | Totally symptom-free; normalization of RV |
| Salam, 2011, (17) | 4 days | Redundant tissue within RA extending from IVC along the CT to the mouth of IVC and from IVC to FO, subdividing RA, protruding into RV through TV | Secundum ASD with a predominantly right-to-left shunt; dysplastic TV with apical displacement of the septal leaflet; flow through TV moving on either side of membrane with minimal obstruction; small hypoplastic RV; raised pulmonary vascular resistance | CN; DD of Ebstein's anomaly | Bluish discolouration over the lips with percutaneous oxygen saturation of 70% | Surgical resection | Normalization of RV and PA pressures; RV size equal to that of LV |
| van Ledden-Klok, 2007, (18) | 2 days | Partition dividing the RA attaching to IAS and adjacent to the orifice of IVC | Obstruction of TV flow with a mean gradient of 5 mmHg; right-to-left shunting across IAS | CTD | Problems with feeding and cyanosis ($SpO_2$ 85%) | Surgical resection | – |
| Tueche, 2003, (19) | – | Partition of RA by a weblike membrane between the PFO and TV | – | CTD | Cyanosis when crying | Surgical resection | Recovered well with normal growth at 12 months of age |
| Cartón, 2011, (20) | 48 hours | Supratricuspid ring in 4-chamber view; highly moving membrane dependent on the Eustachian valve in subcostal view | Transtricuspid, nonobstructive, low-flow pattern with the flow from the IVC diverting through the PFO to LA | CTD | Saturation values remained under 85% despite patency and adequate ductal size | Surgical resection | Uneventful recovery |
| Qureshi, 2014, (21) | 2 weeks | Redundant, mobile membranous aneurysmal strands attaching to IVC-RA junction, near SVC and CS opening; prolapsing through TV into RV | Moderate RV inflow obstruction; right to left shunt | CTD/CN | Mild cyanosis; $SpO_2$ 87%; followed-up at 2 months of age, still active $SpO_2$ of 80–86% | Surgical resection | $5^{th}$ post-operative day with oxygen $SpO_2$ 99% in room air |
| Alghamdi, 2016, (22) | 1 week | Elongated membrane arising from IVC orifice dividing RA into two chambers, partially prolapsing across TV | Directing both blood flow from IVC and SVC to LA via PFO; no significant inflow gradient across TV | CTD | Intermittent episodes of circumoral cyanosis that was not related to feeding; $SpO_2$ 85–88% | Failed interventional therapy; surgical resection at the age of 15 days | Subsequent follow-up showed no residual membrane and there was laminar IVC and SVC flow across TV into a normal sized RV |
| Picciolli, 2022, (23) | 12 hours | Mobile membrane arising from IVC, seemingly reaching the IAS, intermittently engaging through TV | Small right-sided chambers; small PFO | CTD | Isolated cyanotic episodes with peripheral oxygen desaturation (70%) | Surgical resection | Asymptomatic with a normal cardiac physical examination and normal peripheral oxygen saturation |
| Verde, 2017, (24) | 41 hours | Membrane in RA above TV inlet flopping through TV | A hypertrophied small RV, right-to-left shunt across large ASD, and right to left bowing of atrial septum | CTD; ASD | Failed car seat challenge due to episodes of oxygen desaturations (65–88%) | VA-ECMO and surgical resection | Gaining weight and thriving well |
| Gad, 2016, (26) | 6 hours | A prominent EV | Causing blood to shunt right-to-left from the IVC to LA through PFO mainly in diastole | EV | At 26 hours of life, cyanosis and stridor with crying, $SpO_2$ <70% | Conservative followed-up | At 9 months of age: no further episodes of cyanosis; repeat Echo showed regression of the EV |
| Gad, 2016, (26) | 4 days | A prominent EV | PFO with right-to-left shunting during all phases of the cardiac cycle | EV | Failed car seat challenge due to $SpO_2$ as low as 82% and bradycardia | Conservative followed-up | Did not return for scheduled follow-up |
| Gad, 2016, (26) | 72 hours | A prominent EV | PFO with right-to-left shunting in diastole and left-to-right-shunting in systole | EV | Multiple episodes of $SpO_2$ decreasing to 88% | Conservative followed-up | At the 3 months of age: doing well, with normal growth parameters and no further episodes of $O_2$ desaturations |
| Gad, 2016, (26) | 4 days | A prominent EV | PFO with intermittent right-to-left shunting mainly in diastole | EV | Requiring nasal cannula to maintain normal $O_2$ saturations | Conservative followed-up | Did not return for scheduled follow-up |
| Doğan, 2017, (27) | – | A prominent EV | Directing blood from IVC to LA through PFO resulting in right-to left shunting | EV | Cyanosis shortly after birth with $SpO_2$ 64% | Conservative followed-up | At 2 months of age: cyanosis gradually disappeared and no interatrial shunt |
| Aljemmali, 2020, (28) | 5 days | CN attaching to RA free wall, EV, and IAS, protruding into RV without appreciable pressure gradient across TV | Right-to-left shunting through PFO throughout the cardiac cycle | CN | Hypoxemic with $SpO_2$ 88–90% while on room air | Conservative followed-up | Four weeks later: normalization of $SpO_2$; repeated echo showed bidirectional shunting, mainly left-to-right across the PFO without involution of CN |
| Salameh, 2017, (29) | Within 1 day | CN within RA, partly occluding TV causing RV filling impairment | A reversal of flow across PFO | CN | $SpO_2$ levels in late 80s without oxygen supplementation | Conservative followed-up | Improvement in the right ventricular filling and improving saturation |
| León, 2018, (30) | 24 hours | A prominent EV remnant | Directing the majority of inferior caval flow across a PFO with lower-than-expected estimated RV pressure (30 mmHg) | Functional CTD | Oxygen saturations between 70% and 80%; stroke | Conservative followed-up | At 3 months of age: not hypoxic; smaller EV remnant; no right-to-left shunting at PFO |
| Ko, 2011, (31) | 11 days | Redundant, thin, freely mobile transverse membrane dividing RA into two chambers; moving to and for through the TV | Part of vena cava flows guided to PFO with a right-to-left shunt | CN | Mild lip cyanosis since birth; $SpO_2$ 70% | – | – |
| Hurtado-Sierra, 2021, (32) | 18 days | Undulating membrane dividing RA into two chambers and partially prolapsing through TV | The caval veins draining into the posteromedial chamber, with part of its flow redirected by the membrane to LA through PFO | CTD | Intermittent episodes of cyanosis with no signs of respiratory distress, oxygen saturation of 85% | – | – |
| el-Khouri, 1998, (33) | 3 days | Convoluted strands originating from EV and attaching to IAS and CT, floating freely in and out of the RV through the TV during the cardiac cycle | – | CN | – | – | 3 days later: the network moving back and forth between the atrium through the PFO<br>1 week later: the mass of fibers trapped firmly in the LA with occlusion of the FO<br>Over the course of 6 months: the persistent LA mass attached to the left side of the FO; no change in the size of this mass |

TTE, transthoracic echocardiography; RA, right atrium; SVC, superior vena cava; TV, tricuspid valve; RV, right ventricle; TEE, transesophageal echocardiography; PFO, patent foramen ovale; PDA, patent ductus arteriosus; CN, Chiari network; $SaO_2$, oxygen saturation; PV, pulmonary valve; PA, pulmonary atresia; CTD, cor triatriatum dexter; IVC, inferior vena cava; LA, left atrium; ASD, atrial septal defect; $PaO_2$, partial pressure of oxygen; $SpO_2$, peripheral capillary oxygen saturation; CT, crista terminalis; FO, foramen ovale; DD, differential diagnosis; IAS, interatrial septum; CS, coronary sinus; VA-ECMO, venous-arterial extracorporeal membrane oxygenation; EV, Eustachian valve.


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